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IP Interconnection

CRC Mongolia

Ulaanbaatar – 3 December 2024

Philippe Defraigne

Why IP interco matters?

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Saudi regulator latency measurements

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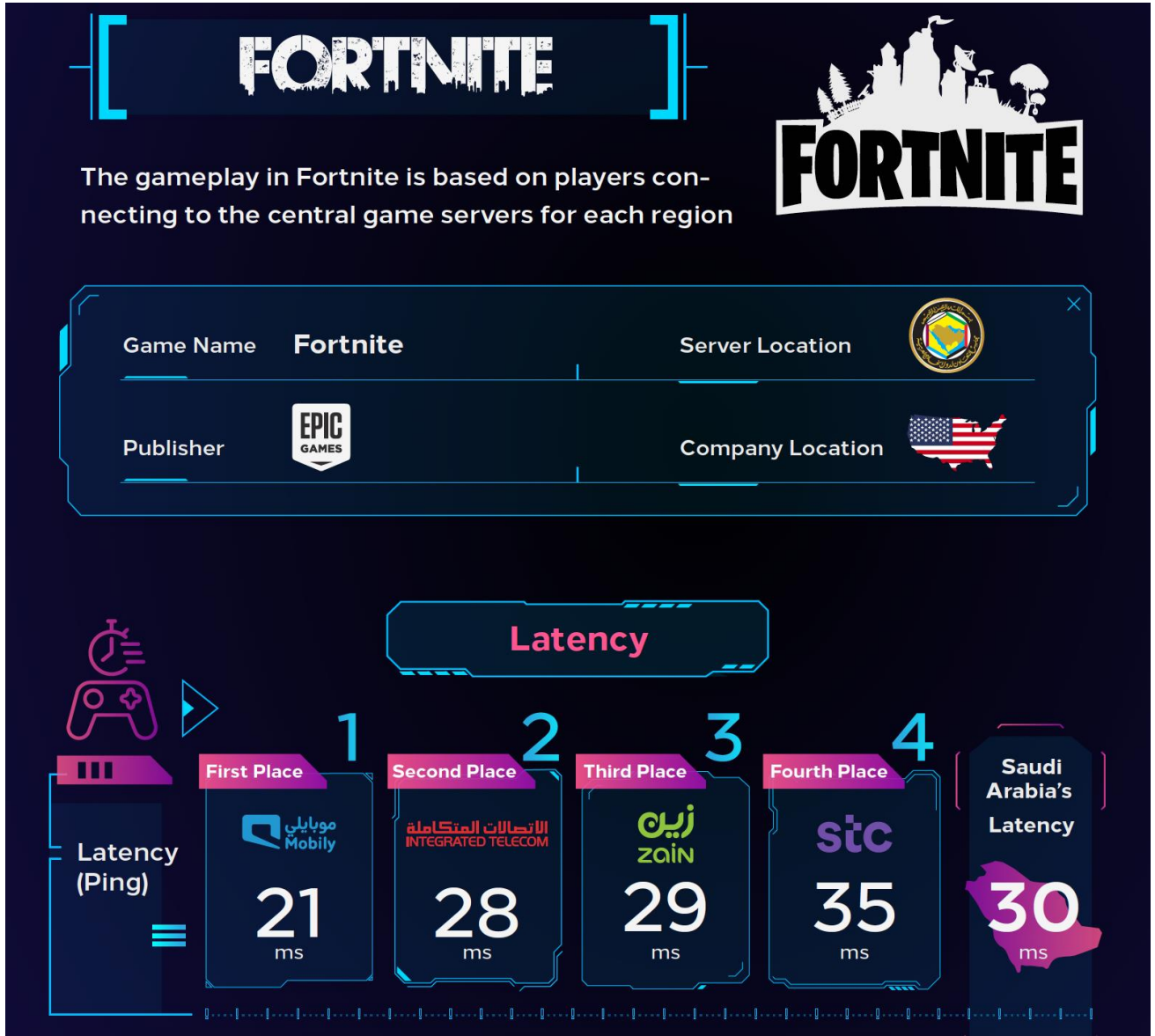
Saudi regulator latency measurements



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Autonomous Systems (ASes)

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Autonomous System (AS)

AS is

- a collection of connected IP routing prefixes
- belonging to a single administrative entity
- that presents a common, clearly defined routing/peering policy to the Internet.

Every AS controls a specific set of IP addresses

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Number of AS Numbers assigned

IPIP Home Internet Exchange Looking Glass AS number search...

Country / Region	Allocated ASNs	Announced ASNs	ASN IPv4 Number	ASN IPv6 Number(/64)
United States	31,262	18,398	1,375,955,433	1,153,848,482,341,585,634
Brazil	9,475	8,629	86,749,864	28,402,157,031,428
China	6,743	5,128	349,679,012	129,960,548,837,104
Russian Federation	5,921	5,001	46,657,498	11,667,391,327,552
Republic of Korea	1,173	890	112,994,472	163,437,936,640
Belgium	390	296	10,441,376	3,374,569,422,848
Mongolia	69	49	166,400	68,719,542,272

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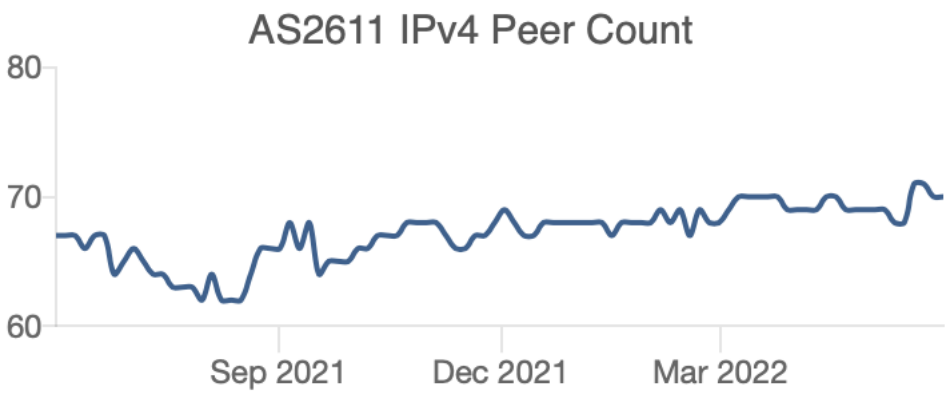
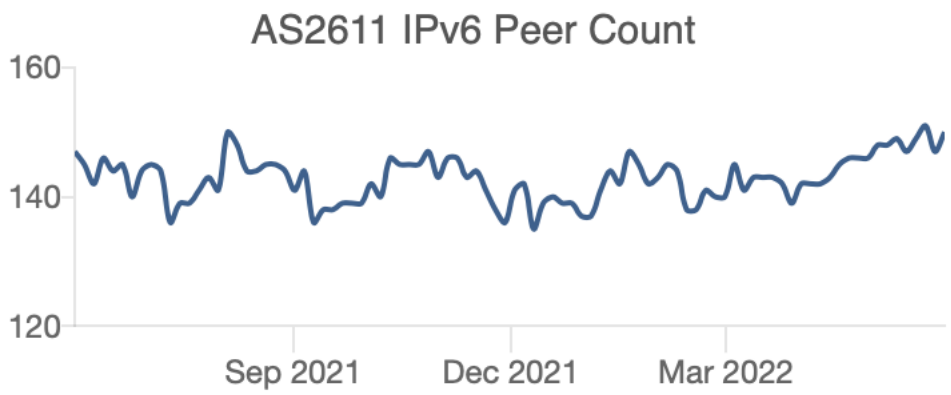
Belnet – Belgian academic and gvt network

Number of peering agreements





Cogent Communications

- Tier 1 Network - Top 5 worldwide
- AS 174
- connected to over 8,820 AS (source)

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Peering policy

ISP generally identify with peering policies categorized as open, selective, or restrictive:

- An open peering policy is where the party peers with any other party.
- A selective peering policy requires that the peering entity must meet the criteria directly specified by the peering policy, such as minimum traffic exchanged, number of peering points, etc.
- A restrictive peering policy is where the party does not generally peer with other parties, where peering is the exception and not the norm.

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Peering policy

Network operators will often include in their published **peering policy a** set of technical requirements and operational requirements. Assuming a network meets the necessary technical requirements to participate in peering on the Internet, peering policy requirements may also include:

- **Routing**: A potential peer is generally required to operate an IP network between the interconnection points and use the Border Gateway Protocol (BGP) to exchange routes at the interconnection points where the peering occurs.

- **Network capacity**: ISPs may impose minimal requirements on the size of a potential peer's network capacity and require that the potential peer ISP operate a fully redundant backbone network in addition to imposing capacity requirements at peering links.

- **Geographic scope**: ISPs may impose requirements that state the potential peer must have a backbone presence in an expansive and diverse set of geographies.

- **Network traffic volumes**: Peering policies may stipulate that the potential peer not exceed an aggregate traffic ratio in a specific direction, for example, the aggregate outbound traffic on the peering links must be no more than twice the volume of aggregate inbound traffic exchanges.

- **Filtering**: Peering policies may also require the potential peer AS to filter route announcements from its customers by prefix, to ensure that incorrect route announcements do not "leak" across the peering link and that no transit or third-party routes are announced or connected.

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ISPs and ASNs

ISPs are commercial companies that provide internet connectivity services to individuals, businesses …

Autonomous Systems represent large networks or groups of networks that operate under a unified routing policy. They serve as the building blocks of the internet.

Network operators need Autonomous System Numbers (ASNs) to control routing within their networks and to exchange routing information with other Internet Service Providers (ISPs).

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IP Interconnection – four options

1. Transit
2. Internet exchange points IXPs (public peering)
3. Bilateral peering (private peering)
4. On-Net Content Delivery Networks (CDNs)

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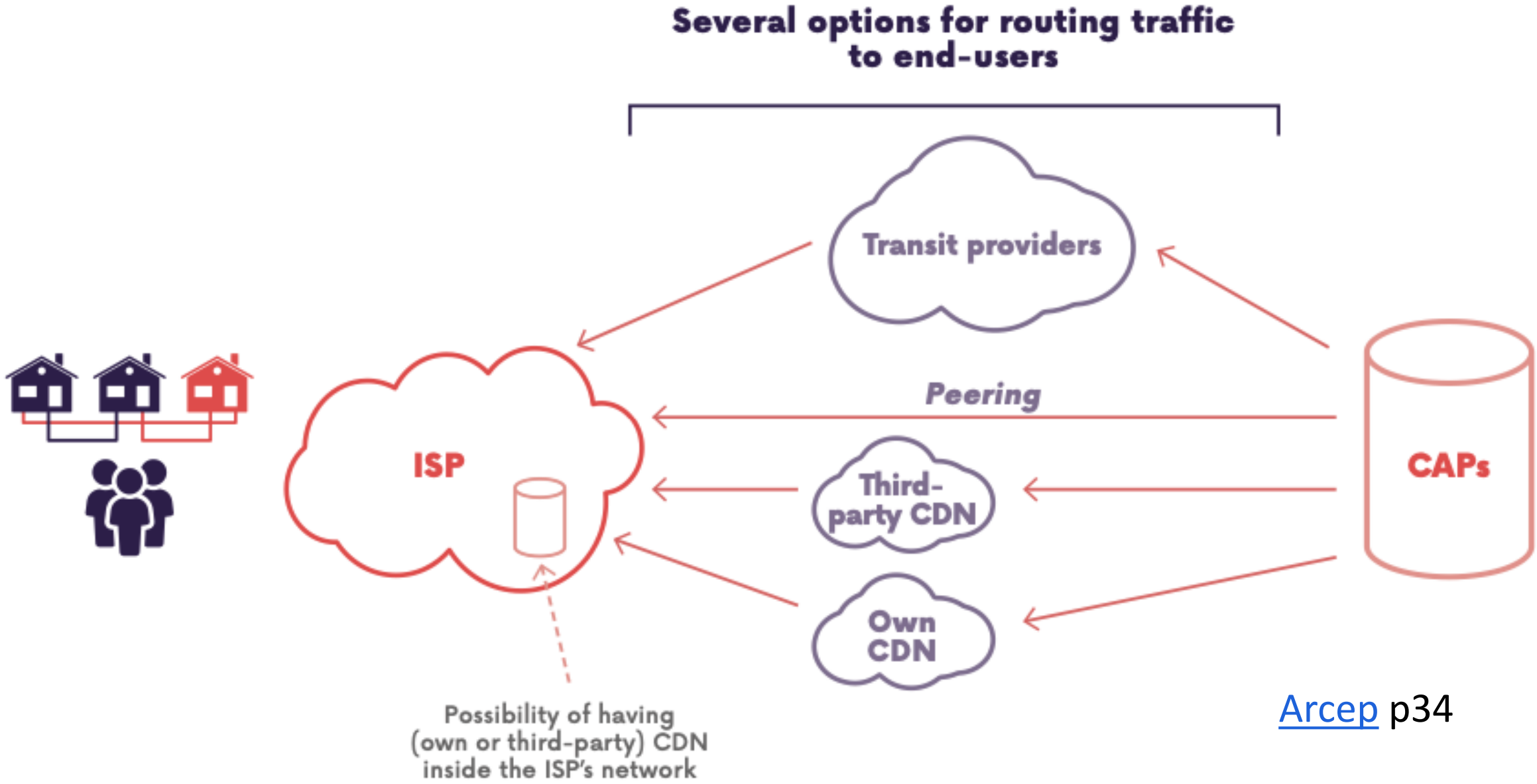
INTERNET TRAFFIC ROUTING



Arcep p34

Transit

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Example – UB company is working on projects with

- A South Korean University
- An Italian engineering company
- An Australian mining company

As an AS, they might decide to buy transit from three different ISPs

Transit

An AS that acts as a router between two ASes is called a transit.

Public peering (IXPs)

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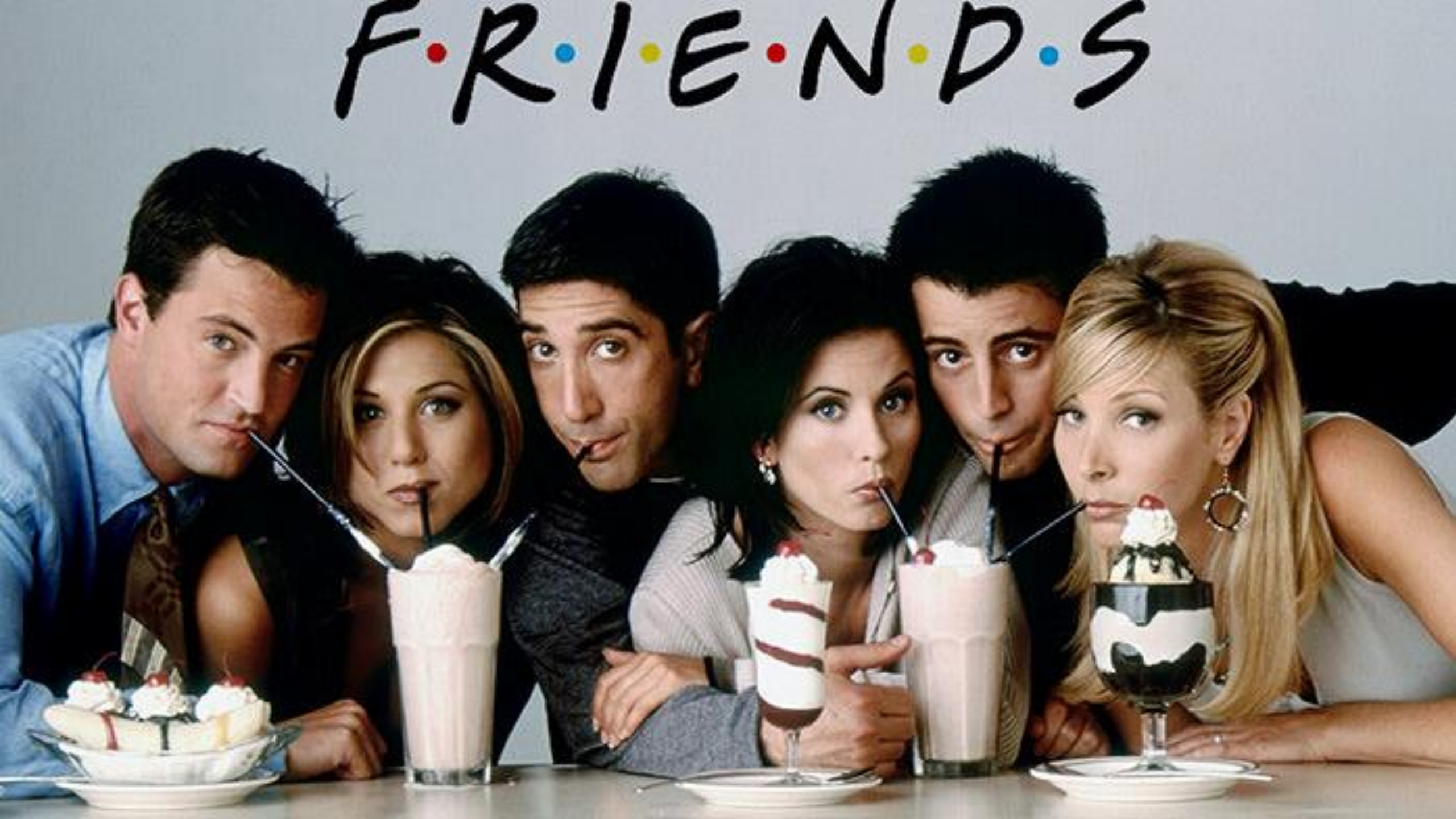
F·R·I·E·N·D·S

IXP – Public peering

- a physical location
- where both ASes and ISPs interconnect using layer 2 protocol (Ethernet)
- possibly in a data center

In practice: telcos, large companies, universities, football clubs, CDNs, web enterprises, cloud and SaaS providers IP interconnect in IXPs

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THE ECONOMIC TIMES | News

English Edition ▾ | Today's ePaper

IXP companies hiking investments amid data centre boom

By Himanshi Lohchab, ET Bureau • Last Updated: Sep 30, 2024, 07:25:00 AM IST

Synopsis

Investments in Internet Exchange Points (IXPs) and peering networks are set to increase in India due to the data centre boom. Companies like Extreme Infocom and DE-CIX India are planning significant investments, aiming to enhance data exchange infrastructure and support growing IT workloads and data consumption by mobile users.

Investments in **Internet Exchange Points** (IXPs) and **peering networks** are set to surge in India amid the **data centre** boom to support increasing IT workloads and strong **data consumption** by **mobile users**.

IXPs, typically, are physical locations where different networks connect to exchange internet traffic via common switching infrastructure. They are responsible for interconnecting internet service providers (ISPs), content delivery networks (CDNs) such as Cloudfare, Akamai, over-the-top (OTT)

Benefit of peering over transit

- Reduced latency, improved round-trip time
- Potentially reduced costs.

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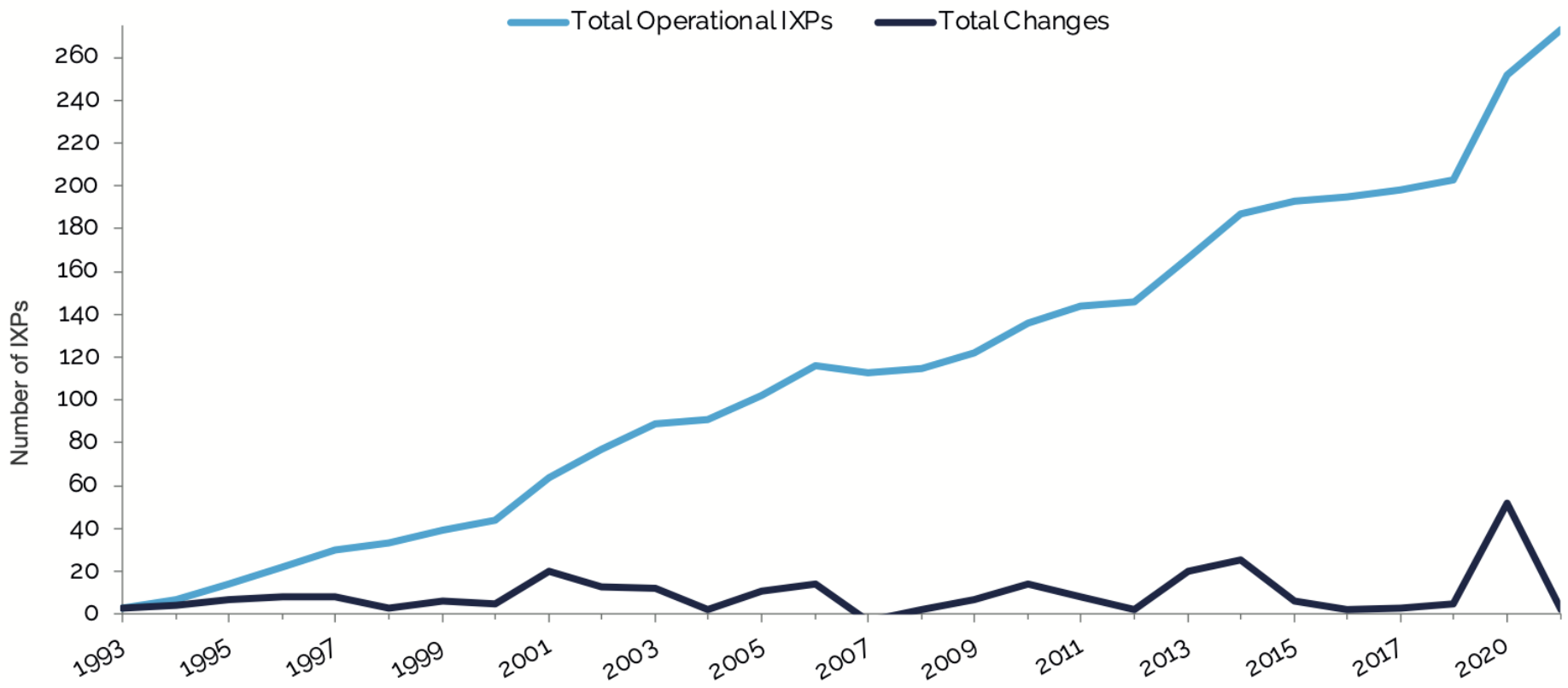
Number of IXPs in Europe

2.1 Number of Operational IXPs in Europe

» IXP Growth in Europe over 10 years



Graph 2.1.1

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IXP traffic

- Peak traffic at IXPs more than **doubled** between 2017 and 2021
- but, **Decrease in relative** importance of IXPs
- growth of **bilateral private peering** traffic is **higher** than that of **multilateral peering**
- Possible explanation: increasing competition from data centers can also provide interconnection services, in addition to hosting services, thus competing with IXPs

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Peer and beer

- Packet Clearing House shows that more than 99% of all agreements, analyse in their report, are “handshake” agreements.
- Packet Clearing House, 2021 Survey of Internet Carrier Interconnection Agreements (December 2021)

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https://ixpdb.euro-ix.net/en/

Top IXPs by Connected Networks

Name	City	Country	Last updated	API	Traffic	MANRS	# of ASNs
IX.br Sao Paulo, SP (SP))	São Paulo	BR	2022-08-16 6:03:31 UTC	✔	✖	✖	2413
FRA (DE-CIX Frankfurt)	Frankfurt am Main	DE	2024-10-29 10:20:33 UTC	✔	✖	✔	1087
AMS-IX	Amsterdam	NL	2024-10-29 10:20:33 UTC	✔	✖	✔	888
LINX LON1 (LINX LON1)	London	GB	2024-10-29 10:20:34 UTC	✔	✖	✔	818
NL-ix	The Hague	NL	2024-10-29 10:20:32 UTC	✔	✖	✔	636
NAPAfrica IX Johannesburg (NAPAfrica)	Johannesburg	ZA	2024-10-29 10:20:32 UTC	✔	✔	✔	583
DataIX Internet Exchange (DataIX Internet Exchange)	Amsterdam	NL	2024-10-29 3:05:32 UTC	✔	✔	✖	567
EPIX (e-Poludnie Internet Exchange)	Warsaw	PL	2024-05-15 16:07:16 UTC	✔	✖	✖	546
Piter-IX (Piter-IX)		RU	2024-07-19 16:03:37 UTC	✔	✖	✖	534
EPIX Warsaw (e-Poludnie Internet Exchange)	Warsaw	PL	2024-05-13 16:05:24 UTC	✔	✖	✖	503

Private peering

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CDNs

Netflix and Telcos/Cable operators

Netflix (AS2906) offers three options to ISPs

- **public peering** at >100 public internet exchanges around the world (Peering Location shared with the Netflix network (AS2906)
- **private peering** at around 80 locations around the world (see peering with Open Connect)
- *'CDN i.e. Open Connect appliance'* boxes (Link)

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Netflix – Open Connect Appliance

- Open Connect appliance
- Single-purpose Content Distribution Network
- No use of third party CDN
- Provided free of charge for ISPs

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CDN

- The increased prevalence of CDNs in IAS providers' networks has been a primary reason for the continuing decrease in transit prices that are observed since 2017.
- Such on-net CDNs exert competitive pressure on these prices, as the demand for long distance transit declines due to local storage of content in CDNs.

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IP Interco market

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BEREC
Body of European Regulators
for Electronic Communications

BoR (24) 93

draft

BEREC Report on the IP Interconnection ecosystem

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Berec report

IAS = Internet Access Services

Based on inbound traffic

Large telcos →

Medium telcos →

Small telcos →

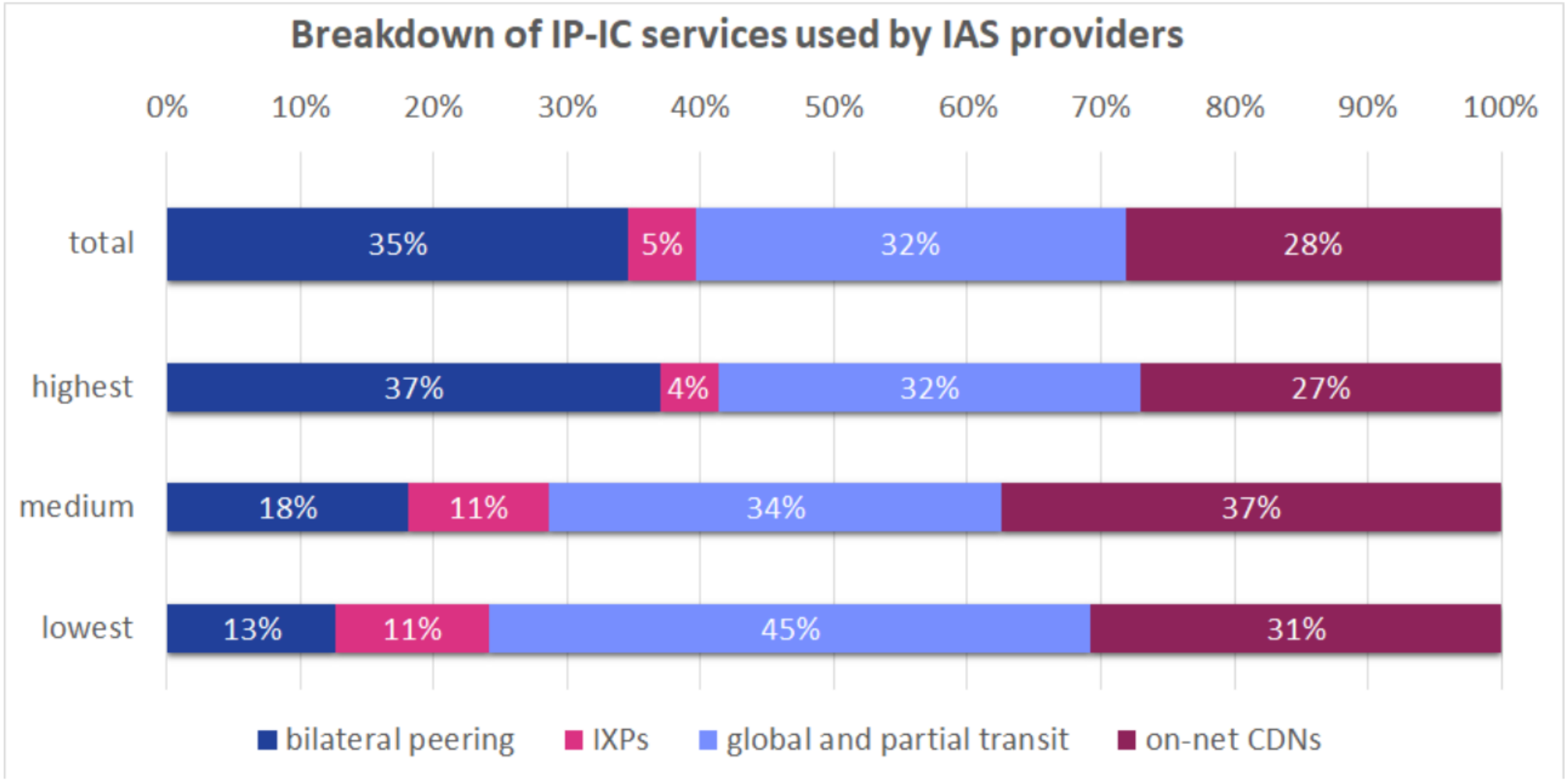

Figure 1. Breakdown of IP-IC services used by IAS providers, Source: BEREC

BEREC report

- The analysis shows that, when low latency and high bandwidth are required peering is rather a substitute for transit than vice versa.

Wool from Scotland and cashmere from Mongolia ☺

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substitution

- Even IAS providers with low inbound traffic peer directly, although to a smaller degree.
- As long as small ISPs have access to IXPs, on-net CDNs and transit to competitive conditions and (small and large) CAPs alike, the size of market players seems less important for market outcomes.

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Thank you!

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